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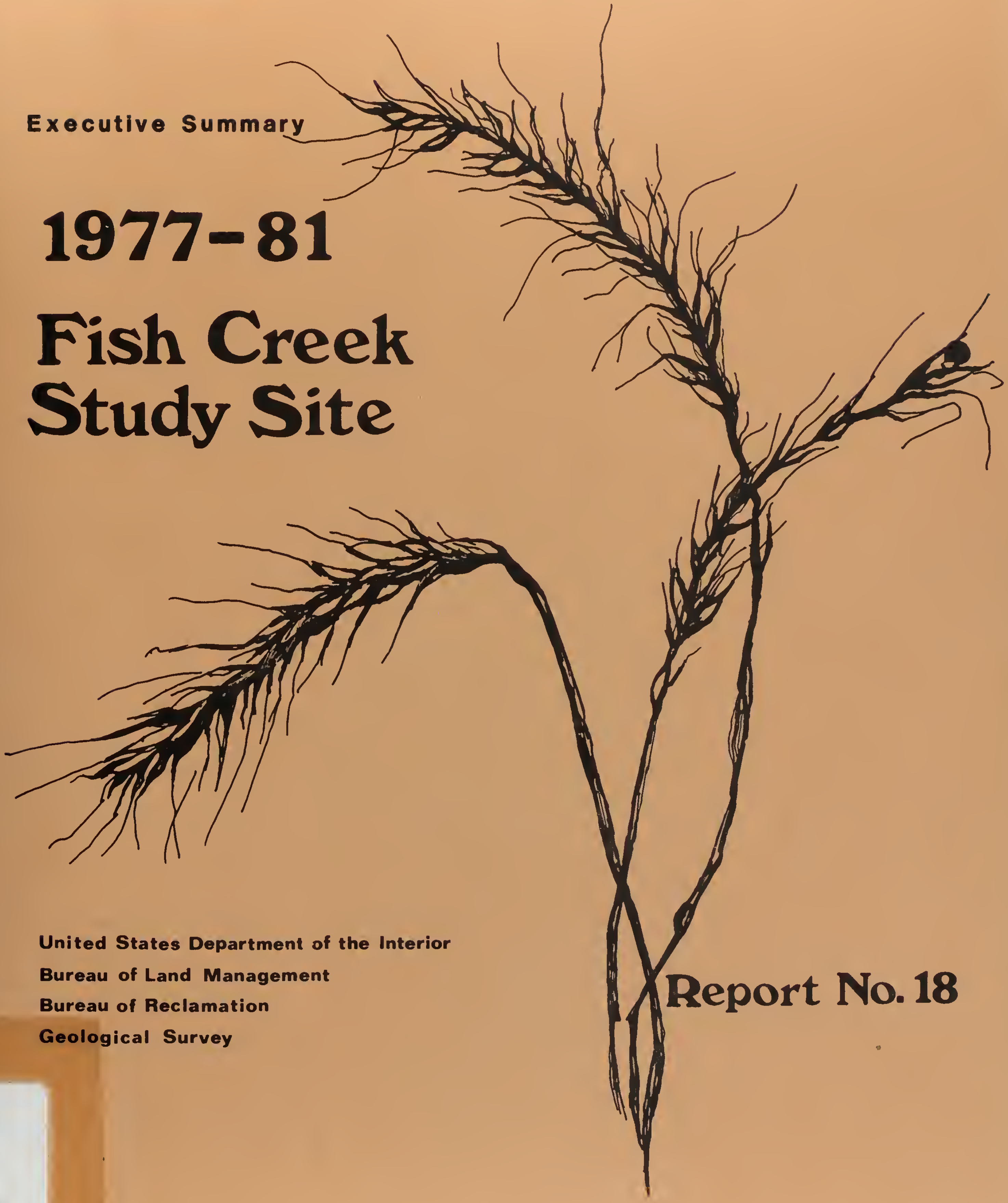
Resource & Potential Reclamation Evaluation

Executive Summary

1977-81
Fish Creek Study Site



United States Department of the Interior
Bureau of Land Management
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16. ABSTRACT

The purpose of this investigation was to collect baseline data for establishing reclamation objectives and lease stipulations. The report includes data on climate, biological and cultural resources, physiography, geology, coal resources, soil overburden, vegetation, and hydrology. The study area is within Routt County in Colorado. The site climate is highland continental. Average annual precipitation is less than 16 inches. The area is composed of a sagebrush riparian ecosystem, inhabiting the bottom land and a mountain shrub ecosystem inhabitating the uplands. The Fish Creek coal bed, as much as 5.4 ft thick, is 2 to 20 ft below the top of the Holderness Member of the Upper Cretaceous Williams Fork Formation. Approximately 79 percent of the study area has adequate soil material for postmining reclamation purposes. Approximately 43 percent of the lands in this area have minimum soil depths of 36 inches consisting of highly suitable material for plant media. Less than 4 percent of the bedrock material could be considered for use as a supplemental source for topsoil replacement.

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17. KEY WORDS AND DOCUMENT ANALYSIS

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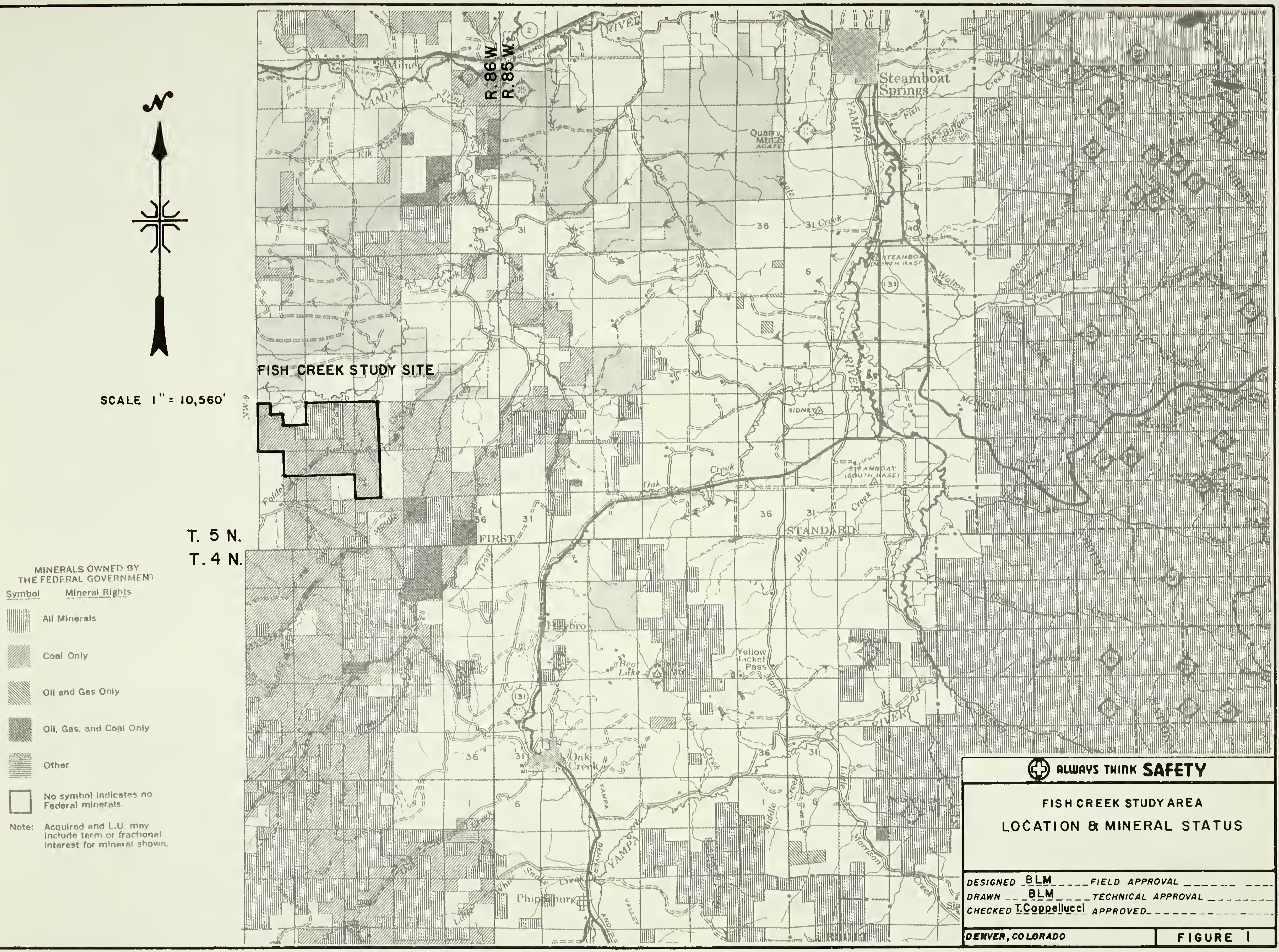

ALWAYS THINK **SAFETY**

FISH CREEK STUDY AREA

LOCATION & MINERAL STATUS

DESIGNED BLM FIELD APPROVAL
DRAWN BLM TECHNICAL APPROVAL
CHECKED T.Cappellucci APPROVED

DENVER, COLORADO

FIGURE 1

PURPOSE

The purpose of this study was to describe the basic resources on the Fish Creek study site, determine the reclamation potential, identify problems involved in reclamation, and recommend measures required to meet reclamation objectives for the area. The reclamation objective is to reclaim the area after mining to its present uses of wildlife grazing and habitat, domestic livestock grazing, and watershed management.

SITE DESCRIPTION

The Fish Creek study site is located approximately 21 miles southwest of Steamboat Springs, Colorado. The lands being studied lie within Routt County and are described below:

T. 5 N., R. 87 W

sec. 20: all except NE1/4 and the NE1/4 of the NW1/4
sec. 21: all
sec. 22: all except E1/2
sec. 27: all except E1/2
sec. 28: all except S1/2
sec. 29: NE1/4

The surface ownership in the study site is private, held mostly by mining companies. The coal minerals are owned by the Federal Government and administered by the Bureau of Land Management (BLM).

The communities of Craig, Hayden, and Steamboat Springs are located north, along U.S. Highway 40. Colorado State Highway 131 is approximately 3 miles southeast of the study site.

The study site lies at an elevation between 6700 and 7400 feet. Precipitation ranges between 15 and 20 inches. Vegetation consists of short grasses, cultivated cropland, and hayland intermixed. Approximately 75 percent of the area has been classified as being under cultivation. The remaining land is considered rangeland.

Fish Creek, a perennial stream, and Foidel Creek, an intermittent stream flow through the study site, providing riparian habitat. The two streams drain the study area.

RESOURCE SUMMARIES

WILDLIFE

The Fish Creek study area is composed of a sagebrush riparian ecosystem inhabiting the bottomland with annual cropland and hayland intermixed. A mountain shrub ecosystem inhabits the upland. Thus, the diversity of vegetation in the area supports a wide variety of mammals and birds.

Deer and elk use the area for summer and winter range. Elk use the upper reaches of Foidel Creek, off the study site, for calving.

A variety of raptors are common users of the ecosystems found in the study area. In addition, the bald eagle may be an occasional winter visitor.

Foidel Creek provides the riparian area with associated use by waterfowl, beaver, and the other associated species. No other data is available for the riparian and aquatic ecosystems.

There are no wild horses using the study site.

CULTURAL RESOURCES

Two surveys for prehistoric and historic values have been conducted in the area. Portions of the surveys are within the reclamation study site (approximately 165 acres). The first is a class II survey conducted by the Laboratory of Public Archaeology (LOPA) during the summer of 1975. Two prehistoric sites were located.

Site 5RT27 is an open campsite on a gently northward sloping bench. It is within an area that has been under cultivation. The LOPA has recommended no further action on the site.

Site 5RT30 is also an open campsite located along both sides of a northwest/southwest trending ridge. The north side of the site is an area that has been under cultivation in the past. The LOPA has recommended the site be nominated to the National Register of Historic Places.

A class III survey was also conducted on approximately 40 acres within the study area boundaries. No prehistoric or historic sites were located.

GEOLOGY AND COAL

The Fish Creek site lies north of the Foidel Creek site in Routt County in Colorado. The outcropping formations, which include coal beds in the general area, are the Iles and Williams Fork Formations. These formations comprise the Mesa Verde Group. The Mesa Verde Group includes the lower, middle, and upper coal-bearing units mined in the Yampa coal field. The Iles Formation contains the lower coal group and is approximately 1,400 feet thick. The Williams Fork Formation, overlying the Iles, contains the middle and upper coal groups. It is approximately 1,200 feet thick.

The Fish Creek coal bed is in the upper portion of the Williams Fork Formation. The coal bed is of interest for this study site because it is the only coal which may occur at levels feasible for surface mining.

The Fish Creek coal bed, within 200 feet of the surface, was evaluated by five core holes. Coal resources--measured, indicated, and inferred--

within the site are 2,512,000 short tons, 7,970,000 short tons, and 507,000 short tons, respectively.

The coal has an apparent rank of bituminous C. The average Btu value of three core samples from the site on the as-received basis is 10,790. Average ash content is 11.1 percent, and average sulfur content is 1.9 percent.

A comparison of the analyses of samples from the Fish Creek coal bed with other Rocky Mountain province coal sample analyses shows that nitrogen, total sulfur, and pyritic and organic sulfur contents are noticeably higher in the Fish Creek coal bed samples. A comparison of other element analyses shows that the Fish Creek coal bed is noticeably higher in As, Cr, F, Fe, Hg, and Sr, and noticeably lower in Th.

SOILS, OVERBURDEN, AND CLASSIFICATION

A detailed land suitability survey was made of the study area to characterize and evaluate the surface and the underlying 10 feet of material in relation to its suitability as a source of planting media for resurfacing shaped spoils following surface mining.

The Fish Creek study site is made up of (1) long upland slopes dissected by small intermittent drainages, (2) smoothly rounded hills and ridges of uplands occurring on the shale formations between Foidel and Fish Creeks, (3) nearly level to gently sloping fans, and (4) flood plains along perennial streams in the area.

The soils in the upland slopes are formed in residuum weathered from sandstone. The soils are of medium and moderately fine textures. Water-holding capacities generally exceed 2 inches per foot. Major portions of this unit have soils which have moderate permeability and infiltration. Structural grades of these soils are strong as characterized by the mature and well-developed profiles. Therefore, they should be stable even after disturbance has occurred. The pH values range from 5.0 to 7.5. These soils are well suited as a source of plant growth medium.

The soils in the hill and ridge areas are brown silty clays and clays with water-holding capacities ranging from 2 to 3 inches per foot. Permeabilities are slow because of their fine textures. Due to the slow infiltration rate and moderately steep gradients, major losses of topsoil have resulted from erosion by water. Structural grades are moderately strong in the upper 2 feet of their profile and range from weak to massive in the lower portions. The pH values range from 6.5 to 8.3. These soils have poor suitability for use as growth media; the primary limiting factor being the soil-water relationships due to silty clay and clay textures.

Soils occurring on the nearly level to gently sloping fans are deep. In most profiles examined, shale or sandstone were encountered below 48 inches. These soils are developing in residuum on old fan terraces and are dominated by silt and sand-size particles and include loam, silt loam, and silty clay loam textures. The permeability rate is medium, and the water-holding capacity ranges from 1.4 to 2.5 inches per foot of depth. The infiltration rates are moderate due to the fine sandy loam and loam surface layers. Structural grades, particularly in the upper 3 feet, are strong. A few profiles within this group have some mottling reflecting somewhat poor drainage due to the impervious nature of the underlying sandstone. Because these soils will not be used in place, this characteristic is not felt to be a limiting factor. The pH values range from 5.9 to 7.5. Soils of this group are generally highly suited as planting media.

The soils in the flood plains are deep, somewhat poorly drained, and generally have appreciable levels of salinity and/or sodicity. The individual soil profiles reflect a moderate degree of stratification and mottling, indicating that high water tables are periodically present. Soil textures include loam, clay loam, silt loam, silty clay, and clay. The medium textures are predominate. Permeabilities are generally moderately slow or very slow. Infiltration rates range from moderate to slow, and structural grades are weak, since alluvial deposition is recent and continuing. Because of the combinations of clayey textures, slow permeabilities, salinity, or sodium, these soils are deemed unsuitable for use as a planting medium.

The land suitability survey classifies lands for their suitability as a source of planting media, taking into consideration many factors including soil depth up to at least 10 feet. An attempt was made to evaluate the overburden material for use as a planting medium. The evaluation was based on data derived from chemical and physical laboratory tests performed on core taken from five deep hole borings drilled on the site.

Toxicity studies were not performed on the Fish Creek soil or overburden samples other than salinity and alkalinity contents. Neither of these are of the magnitude to be toxic in the materials selected as planting media. However, the soils designated as unsuitable in the study exhibited high levels of alkalinity and/or salinity and would be detrimental to plant growth. Plant analysis and growth studies in the greenhouse indicated a high relationship between increased sodium and/or salinity and decrease in yields.

VEGETATION

Seven vegetative types are found on the study site: aspen, mountain shrub, big sagebrush and low sagebrush, winterwheat, hayland, and pasture. The vegetation types are described as follows:

Aspen. The aspen community is located on north-facing slopes in areas with the best moisture conditions interspersed within elements of the mountain shrub community. The aspen community supports a rich variety of grasses and forbs.

Mountain Shrub. The mountain shrub community is on the north-facing slopes and south-facing rock outcrops of the area, depending on soil depth, texture, and available moisture. This type supports many important browse species, including serviceberry, snowberry, and chokecherry. Other associated shrubs are big sagebrush and green rabbitbrush.

Big Sagebrush. The big sagebrush community occurs below the elevation range of the mountain shrub community and occupies deep, well-drained, fine sandy loam soils. In some areas, this community is in the relatively productive soils associated with croplands but are on slopes which are too steep for cultivation. This community is used primarily for grazing.

Big sagebrush is the dominant shrub and is associated with scattered snowberry, bitterbrush, Kentucky bluegrass, lupine, penstemon, and gromwell.

Low Sagebrush. The low sagebrush community occurs below the elevation range of the mountain shrub community adjacent Fish Creek. It is on deep, well-drained, silty day loam soils. Low sagebrush is the dominant shrub and is associated with green rabbitbrush, big sagebrush, and includes some forbs and grasses.

Winterwheat (cropland). Winterwheat croplands of the area are on fine sandy loam and loams formerly occupied by the sagebrush community. Approximately half of the cropland is in summer fallow while the remaining is under cultivation. The fallow areas may contain some grasses and forbs such as rye, oats, smooth brome, penny cress, thistle, and sunflower.

Hayland. The hayland is located on the same soil types as the winterwheat croplands, but on flatter, more productive sites. In some areas, there is a possibility for subirrigation. Smooth brome and alfalfa are the primary seeded species.

Pasture. The pasture is located on the same soils as wheatland and hayland where the predominate grass, smooth brome, has been seeded. These areas, which are pastured, usually have too low a production for hayland or the terrain is too rough for haying.

CLIMATE AND HYDROLOGY

The rugged topography of western Colorado, and specifically the site, causes large variations in climate within short distances. Annual precipitation in the study area is approximately 16 inches, with a seasonal average of 8.1 inches during the summer and 7.9 inches during the winter. Extreme differences in year-to-year and season-to-season precipitation may cause problems in revegetation effort. The maximum evaporation rates occur in midsummer when temperatures are highest. Average annual evapotranspiration at the study site is approximately 23 inches.

Seasonal mean temperatures are 35° F for winter (October to March) and 57° F for summer (April to September). Below freezing temperatures year-round and a chance of greater than 100° F temperature in the midsummer months of June and July are possible.

The effective growing season at the site can be approximated from mid-May to mid-September (131 days) and the period of mean daily temperature greater than 32° F, which is from late March to mid-November (235 days).

Available ground-water data within the study area consist of five observation wells which were constructed in 1976. The aquifer units in the areas consist of sandstones within the Williams Fork Formation. The Williams Fork Formation ranges from 1,100 to 2,000 feet in thickness and contains the Fish Creek coal bed.

Principal ground-water withdrawal in areas adjacent the site is mainly from the alluvium or the unconfined part of the Williams Fork Formation. Within boundaries of the study site, there is currently no withdrawal from the ground-water system except by natural discharge of ground water to Foidel Creek and Fish Creek.

Recharge to the rock units within the study site area results from infiltration of precipitation and snowmelt. The amount of recharge is not known, but is probably less than 1 percent of the annual precipitation. There is some recharge to the alluvium during periods of high discharge in Foidel Creek and Fish Creek. However, this water is immediately released as the stage decreases. Direct recharge to deeper aquifers may occur where streams cross the northwest-southwest trending faults. Small stock ponds within the study site probably do not contribute to recharge because of the high evaporation rates and silting of the pond bottoms.

The majority of annual runoff originates in snowmelt during the spring months, as reflected in the streamflow records for Foidel and Fish Creeks.

The effects of mining on the quantity of runoff differs for each stream in the proposed study area because of the size of the drainage area and the location of each stream channel through the study site. As the contributing area from the study site is relatively small to the total drainage area, the effects upon streamflow should be minimal.

The bed and banks of the Foidel Creek and Fish Creek channels consist primarily of silts and clays. The valleys in which these streamflow consist primarily of fine-grain material. Disruptions near the channel could, therefore, increase suspended-sediment concentrations dramatically. Once in suspension, this fine-grain material could travel great distances downstream.

RECLAMATION POTENTIAL AND ALTERNATIVES

Post-Mining Land Use Objectives

The entire surface area of the study site is privately owned. Approximately 75 percent of the area has been classified as being under cultivation. The cultivated land is used to produce small grain, wheat, and hay for winter livestock feed and improved pasture. The remaining land is used for grazing cattle and wildlife grazing and habitat.

Post-mining reclamation should ensure the continued present uses at approximately the same levels or improve production if possible. Reclamation should ensure the return of air and water quality to or above the quality prior to mining. Reclamation techniques should also consider the visual and scenic values prior to mining and blend the land rehabilitation efforts into the surrounding landscape.

Summary of Reclamation Problems and Recommended Measures

Based on the land suitability specifications, 43 percent of the study site would be most desirable as a source of revegetation material for post-mining reclamation purposes. These lands which have been classified as suitable for revegative material, particularly those classified as Class 1, reflect very few adverse chemical conditions based on laboratory evaluations of the surface and upper soil materials.

Approximately 36 percent of the lands classified as having limited suitability have clay, silty clay, and clay loam soils. Once disturbed, these soils lose the amount of natural structure they have. Therefore, water movement will be impeded, wind erosion is likely, and additional land treatment will be necessary during reclamation revegetation.

The remaining lands in the study area have soil deficiencies or may require good placement practices to prevent contamination. The chemical and physical characterizations of the geologic overburden material (10 feet to bottom of coal seam) were characterized for five deep hole locations. Overall, these materials exhibited saline and soidic conditions. These or similar materials would be unfavorable for use as a plant growth media. However, the soil quantity and quality evaluations made of the upper 10 feet of area indicate that a successful revegetation program is feasible if the topsoils or soils identified as suitable in the land suitability survey are used as planting media.

Laboratory fertilizer analyses were not performed on the soils collected in the area. Selected toxicity analysis of trace elements and heavy metals that could be detrimental to surface and ground-water supplies and general consumption should be conducted prior to preparing a mining plan.

Variability of precipitation is the greatest constraint to revegtation. Reclamation strategy should include plans and resources for multiple seeding attempts. Supplemental water should be considered, although it probably would be more economically feasible to have an occasional failure and replanting.

Careful selection of plant species with respect to climate sensitivity is critical. Local experience can be provided by reclamation specialists, seed suppliers, and state extension agents. Site-specific experimental field studies can also be carried out to provide specific requirements for selected species.

The beds and banks of Foidel Creek and Fish Creek channels consist primarily of silts and clays. Also the valleys in which these stream flow consist primarily of fine-grain material. Disruptions near the channel could increase suspended-sediment concentrations dramatically. Once in suspension, this fine-grain material could travel great distances downstream.

When mining is carried out below the potentiometric surface, some dewatering may be necessary. The amount of withdrawal can only be determined after the mine plan is known. The permeability of the spoil differs drastically from undisturbed rocks. At first, the permeability is greater than that of the undisturbed rocks. But as the spoil compacts, permeability is gradually reduced. This reduction in permeability means a decrease in the release of dissolved minerals. Where the Fish Creek coal bed is extracted beneath the Lewis Shale, which is high in secondary gypsum, increases in sulfate concentrations can be expected in both Fish Creek and Foidel Creek.

Mining techniques and regulations in force at the time mining occurs will dictate whether the suitable topsoil will be stockpiled for later use or moved directly from the mining site to areas being rehabilitated in the Fish Creek site. Bedrock materials identified as unsuitable should be separated and placed at a depth greater than 10 feet below the reconstructed surface soil profile. Toxic materials should be identified and properly placed to prevent pollution of ground waters or contamination of surface water.

Regulations will prevent any mining activities within the flood plain of Foidel or Fish Creeks. Additionally, buffers should be installed between the mine and these main channels to prevent sediment from reaching their waters. Tributary streams should be completely impounded above the mine site.

The use of water control structures is acceptable and recommended. They should not be used where water retention and subsequent percolation will increase total dissolved solids concentrations. Large sediment basins should be located below spoils piles rather than in them. All water and erosion control structures should be designed to limit their effective life to not greater than 10 years and not less than 5 years. Following the reclamation period, remaining water or sediment control structures should be removed.

Restructured slopes should resemble premining conditions. Long slope segments over 4 to 5 percent should be interrupted by terraces. Slope segments between terraces should not exceed 50 to 100 feet in length, depending on the slope steepness. When possible, south exposures should be minimized and graded relatively flat to lessen the microclimate effects on revegetation.

To improve filtration, chiseling of the topsoil prior to planting is recommended. Also, on slopes over 20 percent, gouger pitting and/or contour furrowing is recommended. Erosion control structures should have an effective life between 5 and 10 years.

Reclamation efforts should be toward the development of diverse and self-perpetuating plant communities. Precipitation patterns of the area indicate species that take advantage of early spring moisture, germinate early, and concentrate growth during the early growing season would establish and sustain most effectively.

Any practice that would enhance natural revegetation on the area to be turned to rangeland should be initiated in the reclamation process. Transplanting pads of natural shrubbery vegetation will provide a quick wildlife cover and enhance natural revegetation. If a mulch is applied for improvement of soil, it should be incorporated into the soil before seeding. Following placement of the plant growth media, a seedbed should be prepared.

Post-Mining Land Management

Proper post management of the reclaimed area is essential if reclamation is to be successful. The reseeded rangeland and pastureland should be protected from grazing until vegetation is sufficiently established to withstand grazing without damaging the vegetation cover. If weed growth prevents the survival of the seeded species during establishment, acceptable methods of weed control should be used. (After the vegetation is established, a planned grazing system should be used.) A portion of the precipitation runoff should be intercepted by reservoirs following reclamation. These impoundments will provide water for wildlife and livestock. A rotation cropping should be initiated on the cropland following reclamation. On all reclaimed land, regardless of its post-mining use, corrective measures should be taken to stop erosion. To maintain adequate fertility levels in the soil, a fertility program of several years may be necessary.

Alternatives for Reclamation

The present land is used for cultivation of small grain, wheat, and hay for winter livestock feed and improved pasture. The rangeland is used for grazing cattle and providing grazeland and habitat for wildlife. It is assumed that the area will be reclaimed to these uses. Furthermore, it is possible that more land could be put into crop production where soils and slopes would permit. This would provide more food for human consumption than is possible from native vegetation. Since 75 percent of the areas are now being farmed, it is also possible to develop more areas for wildlife habitat rather than returning it to its former use.

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